PART 1 - GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

| | |
|---|---|
| ANSI B16.18 | (1984; R 1994) Cast Copper Alloy Solder Joint Pressure Fittings |
| ANSI B16.24 | (1991; Errata 1991) Cast Copper Alloy Pipe Flanges and Flanged Fittings Class 150, 300, 400, 600, 900, 1500, and 2500 |
| ANSI S1.4 (ASA 47) | (1983; R 1994) Sound Level Meters |

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

| | |
|---|---|
| ASME B1.1 | (1989) Unified Inch Screw Threads (UN and UNR Thread Form) |
| ANSI/ASME B1.20.1 | (1983; R 1992) Pipe Threads, General Purpose (Inch) |
| ASME/ANSI B16.1 | (1989) Cast Iron Pipe Flanges and Flanged Fittings |
| ANSI/ASME B16.3 | (1992) Malleable Iron Threaded Fittings |
| ASME/ANSI B16.5 | (1996) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 |
| ASME/ANSI B16.9 | (1993) Factory-Made Wrought Steel Butt welding Fittings |
| ASME B16.11 | (1996) Forged Fittings, Socket-Welding and Threaded |
| ASME B16.21 | (1992) Nonmetallic Flat Gaskets for Pipe Flanges |
| ASME/ANSI B16.22 | (1995) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings |
| ASME/ANSI B16.34 | (1996) Valves - Flanged, Threaded, and Welding End |
| ASME/ANSI B16.39 | (1986; R 1994) Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300 |
| ASME/ANSI B18.2.2 | (1987; R 1993) Square and Hex Nuts (Inch Series) |
| ASME/ANSI B31.9 | (1996) Building Services Piping |

| | |
|---|---|
| ANSI/ASME B40.1 | (1991; Special Notice 1992) Gauges - Pressure Indicating Dial Type – Elastic Element |
| ASME BPVC SEC VIII D1 | (1995; Addenda 1995 and 1996) Boiler and Pressure Vessel Code: Section VIII Pressure Vessels, Division 1 |

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

| | |
|---|---|
| ASSE 1003 | (1993; Errata 1993) Water Pressure Reducing Valves |
| ASSE 1017 | (1986) Temperature Actuated Mixing Valves for Primary Domestic Use |

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

| | |
|---|---|
| ASTM A 47M | (1990; R 1996) Ferritic Malleable Iron Castings (Metric) |
| ASTM A 47 | (1990) Ferritic Malleable Iron Castings |
| ASTM A 53 | (1996) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless |
| ASTM A 123 | (1989; Rev. A) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products |
| ASTM A 183 | (1983; R 1990) Carbon Steel Track Bolts and Nuts |
| ASTM A 194/A 194M | (1996) Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service |
| ASTM A 307 | (1994) Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength |
| ASTM A 536 | (1984; R 1993) Ductile Iron Castings |
| ASTM B 32 | (1996) Solder Metal |
| ASTM B 88M | (1996) Seamless Copper Water Tube (Metric) |
| ASTM B 88 | (1996) Seamless (1996; Rev. A) Copper Water Tube |
| ASTM D 1785 | Plastic Pipe Poly(Vinyl Chloride) (PVC) Schedules 40, 80, and 120 |
| ASTM D 2000 | (1996) Rubber Applications Products in Automotive and Pipe-Line Expansion Joints |
| ASTM F 1007 | (1987; R 1993)Circular Metallic Bellows Type Expansion Joints for Piping Application |

| | |
|---|---|
| ASTM F 1120 | (1986; R 1991) of the Packed Application Type Expansion Joints for Piping Application. Slip Type for Marine |

AMERICAN WELDING SOCIETY, INC. (AWS)

| | |
|---|---|
| ANSI/AWS 249.1 | (1994) Safety in Welding, Cutting and Allied Processes |

COPPER DEVELOPMENT ASSOCIATION (CDA)

| | |
|---|---|
| CDA 404 | Copper Tube Handbook |
| MSS SP-58 | Safety Color Code for Marking Physical Hazards |
| MSS SF-67 | Mechanical Power Transmission Apparatus |
| MSS SP-69 | COMMERCIAL ITEM DESCRIPTIONS (CID) (Rev. B) Tape, Pressure-Sensitive Adhesive, (Plastic Film) |

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCCHR)

List of Approved Backflow Prevention Assemblies

| | |
|---|---|
| MSS SP-72 | (1992) Ball Valves with Flanged or Butt-Welding Ends for General Service |
| MSS SP-80 | (1997) Bronze Gate, Globe, Angle and Check Valves |
| MSS SP-11.0 | (1992) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends |

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

| | |
|---|---|
| NEMA ICS 2 | (1993) Industrial Control and Systems Controllers, Contactors and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC |
| NEMA ICS 6 | (1993) Industrial Control and Systems Enclosures |
| NEMA MG 1 | (1993; Rev. 1-4) Motors and Generators |

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION, INC. (SMACNA)

| | |
|---|---|
| SMACNA HVACTAB | (1993) HVAC Systems Testing, Adjusting and Balancing |

1.2 RELATED REQUIREMENTS

Section 15050, "Basic Mechanical Materials and Methods" applies to this section with additions and modifications specified herein.

## 1.3 SYSTEM DESCRIPTION

Except as specified otherwise, equipment and piping components shall be suitable for use in low temperature water heating system. Except as modified herein, the pressure temperature limitations shall be as specified in the referenced standards and specifications. Pressures in this specification are pressures in pounds per square inch above atmospheric pressure, and temperatures are in degrees Fahrenheit (F).

### 1.3.1 Hot Water Heating System

Submit plan, elevations, dimensions, capacities, and ratings. Include the following:

a. Unit heaters

b. Pumps

c. Valves

d. Expansion tanks

e. Flow measuring equipment

f. Backflow preventer

g. Air separating tank

h. Boilers

i. Heating Coils

## 1.4 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

### 1.4.1 SD-01, Shop Drawings

a. Hot water heating system

### 1.4.2 SD-02, Product Data

a. Coils

b. Pumps include pump speed and characteristic curve for performance of impeller selected for each pump. Curves shall indicate capacity vs head, efficiency, and brake power for full range, from shut-off to free delivery.

c. Valves

d. Expansion tanks

e. Flow measuring equipment

f. Backflow preventers

g. Boiler

h. External air separation tanks

i. Hot water heating pipe Fittings

j. Mechanical pipe coupling system

1.4.3 SD-03, Test Reports

a. Hydrostatic test of piping system

b. Auxiliary equipment and accessory tests

c. Submit test reports in accordance with the paragraph entitled "Field Quality Control."

1.4.4 SD-04, Certificates

a. Backflow preventer certification

b. Report of prior installations

c. Welding procedures

d. Welder's qualifications

1.4.5 SD-5, Operation and Maintenance Data

a. Pumps, Data Package 3

b. Boilers, Data Package 3

c. Water Treatment Equipment, Data Package 3

Submit operation and maintenance data in accordance with Section 01781, "Operation and Maintenance Data." Submit a list of qualified service organizations which includes addresses and qualifications.

1.5 QUALITY ASSURANCE

1.5.1 Welding

1.5.1.1 Report of Prior Installations

1.5.1.2 Welding Procedures

Before performing welding, submit three copies of welding procedure specification for all metals to be used in the work, together with proof of welder's qualification as outlines in ASME/ANSI B31.9.

1.5.1.3 Welder's Qualifications

Before welder or operator performs welding, submit three copies of Welder's Performance Qualification Record in conformance with ASME/ANSI B31.9showing that the welder was tested under the approved procedure specification submitted by the Contractor. In addition, submit each welder's assigned number, letter, or symbol used to identify the work of the welder.

1.5.1.4 Identification of Welder's Work

Ensure that each welder's assigned number, letter or symbol is affixed immediately upon completion of the weld. To welders making defective welds after passing a qualification. test, give a re-qualification test. Upon failing to pass the test, do not permit welder to work in this contract.

1.5.1.5 Previous Qualifications

Welding procedures, welders, and welding operators previously qualified by test may be accepted for this contract without re-qualification subject to the approval and provided that all the conditions specified in ASME/ANSI B31.9 are met before a procedure can be used.

1.5.2 Brazing and Soldering

1.5.2.1 Brazing Procedure

ASME/ANSI B31.9. Brazing procedure for joints shall be as outlined in CDA 404/0.

1.5.2.2 Soldering, Soldering Preparation, and Procedures for Joints

ASME/ANSI B31.9 and as outlined in CDA 404/0.

1.5.3 Backflow Preventer Certification

Submit. a Certificate of Full Approval or a current Certificate of Approval for backflow preventers.

1.6 SAFETY STANDARDS

1.6.1 Welding

Safety in welding and cutting of pipe shall conform to ANSI/AWS 249.1.

1.6.2 Guards

Couplings, motor shafts, gears and other moving parts shall be guarded, in accordance with OSHA 29 CFR 1910.219. Guards shall be cast iron or expanded metal. Guard parts shall be rigid and removable without disassembling the guarded unit.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

2.1.1 Hot Water Heating Pipe (Supply and Return)

ASTM A 53 electric resistance welded or seamless Schedule 40 steel pipe or ASTM B 88M ASTM B 88 Type L hard drawn Copper tubing.

2.1.2 Fittings

Provide fittings compatible with the pipe being provided and shall conform to the following requirements .

2.1.2.1 Steel or Malleable Iron Pipe

Sizes 1/8 to 2 inches. ASME B16.11 steel socket welding or screwed type or ANSI/ASME B16.3 for screwed type malleable iron fittings.

2.1.2.2 Steel, Cast Iron, or Bronze

Sizes 2 1/2 inches and above. Steel fitting butt welding type ASME/ANSI B16.9 or ASME/ANSI B16.5 flanged type. Cast iron fittings flanged type ASME/ANSI B16.1. Bronze fittings up to 8 inch size flanged type ANSI B16.24.

2.1.2.3 Fittings for Copper Tubing

ANSI B16.18 cast bronze solder joint type or ASME/ANSI B16.22wrought copper solder joint type. Fittings may be flared or compression joint type.

2.1.3 Mechanical Pipe Coupling System

Couplings may be provided for water temperatures not to exceed 200 degrees F. Couplings shall be self centering and shall engage and lock in place the grooved or shouldered ends of pipe and pipe fittings in a positive watertight couple. Couplings shall be designed to permit some angular pipe deflection, contraction, and expansion. Coupling clamp shall be ductile iron conforming to ASTM A 536, Grade 65-45-12. Gasket shall be molded rubber conforming to ASTM D 2000, the "line call-out" number shall be suitable for a water temperature of 230 degrees F. Coupling nuts and bolts shall be steel conforming to ASTM A 183. Fittings shall be grooved malleable iron conforming to ASTM A 47, Grade 32510 or ductile iron conforming to ASTM A 536, Grade 65-45-12 or malleable iron conforming to ASTM A 47, Grade 32510. Mechanical couplings and fittings shall be of the same manufacturer. Before assembling couplings, coat pipe ends and outsides of gaskets with lubricant approved by the coupling manufacturer to facilitate installation.

2.1.3.1 Groove and Check Valves

Grooved end, dual disc, spring loaded, non-slam check valves with Type 316 stainless steel or aluminum bronze discs and EPDM rubber seats. Maximum rated working pressure of 500 psig dependent on size. Tested in accordance with MSS SP-71.

2.1.3.2 Butterfly Valves

Grooved end butterfly valves with ductile iron body and disc core to ASTM A 536. Disc rubber connected with EPDM rubber. Maximum rated working pressure of 300 psig tested in accordance with MSS SP-67.

2.1.3.3 Strainers

Include grooved end T-type strainers with steel or ductile iron bodies, Type 304 removable strainer baskets with 6 or 12 mesh screens and 57 percent open area. Maximum rated working pressure of 750 psig dependent on size.

2.1.4 Unions

2.1.4.1 Steel Pipe

Provide ASME/ANSI B16.39, malleable iron unions, threaded connections.

2.1.4.2 Copper Tubing

Provide FS WW-U-516, bronze unions, solder joint end.

2.1.4.3 Dielectric Union

Provide insulated union with galvanized steel female pipe-threaded end and a copper solder joint end conforming with ASME/ANSI B16.39, Class 1, dimensional, strength and pressure requirements. Union shall have a water-impervious insulation barrier capable of limiting galvanic current to one percent of the short-circuit current in a corresponding bimetallic joint. When dry, insulation barrier shall be able to withstand a 600-volt breakdown test.

2.1.5 Flanges

Remove raised faces when used with flanges having a flat face.

2.1.5.1 Steel Flanges

ASME/ANSI B16.5 forged steel, welding type.

2.1.5.2 Cast Iron Screwed Flanges

ASME/ANSI B16.1.

2.1.5.3 Bronze Screwed Flanges

ANSI B16.24.

2.1.6 Drains and Overflows

2.1.6.1 Steel Pipe

ASTM A 53 Seamless Schedule 40, Malleable iron or forged steel fittings, screwed or welded joints.

2.1.6.2 Copper Tubing

ASTM B 88MASTM B 88, Type L hard drawn, cast brass or wrought copper fittings, Grade Sb5 solder joints.

2.1.7 Valves

Valves shall have rising stems and shall open when turned counterclockwise.

2.1.7.1 Gate Valves

a. Bronze Gate Valves: MSS SP-80, 2 inches and smaller, wedge disc, inside screw type not less than Class 150. Use solder joint ends with copper tubing.

b. Steel Gate Valves: ASME/ANSI B16.34, provide with open stem and yoke type with solid wedge or flexible wedge disc and heat and corrosion-resistant steel trim.

c. Cast Iron Gate Valves: MSS SP-70, 2 1/2 inches and larger, open stem and yoke type with bronze trim.

d. Cast Iron Globe and Angle Valves: MSS SP-85, 2 1/2 inches and larger, with bronze trim, tapped drains and brass plug.

2.1.7.2 Check Valves

a. Bronze Check Valves: MSS SP-80, 2 inches and smaller, regrinding swing check type, Class 200.

b. Cast Iron Check Valves: ASME/ANSI B16.34, 2 1/2 inches and larger, bronze trim, non-slam, eccentric disc type for centrifugal pump discharge service.

2.1.7.3 Plug Valves

MIL-V-12003, except that a replaceable valve seat will not be required. Type I -lubricated, tapered plug valves. Use for natural gas service only.

2.1.7.4 Ball Valves

Flanged or butt-welding ends ball valve shall conform to MSS SP-72, steel. Threaded, socket-welding, solder joint, grooved and flared ends shall conform to MSS SP-110.

2.1.7.5 Flow Control Valves

Flow control valves shall be specially designed for HVAC Piping system applications and shall automatically control flow over pressure range of 1-13 PSID. Valves to be of self cleaning design and have stainless steel flow elements with seals compatible with heating water temperatures and water treatment chemicals.

2.1.7.6 Butterfly Valves

Conform with MSS SP-67, Type I - Tight shut off valve, and flanged lug type valve ends. Valve body material shall be cast iron, steel or bronze and shall be bubble tight for shutoff at 150 psig. Valves shall have Type 300 series corrosion resistant steel stems and corrosion resistant or bronze discs with molded elastomer disc seals. Flow conditions shall be for the regulation from maximum flow to complete shutoff by way of throttling effect. Valves shall be provided in closed system.

Valves smaller than 6 inches shall have throttling handles. Valves shall have a minimum of 7 locking positions and shall be suitable for water temperatures up to 200 degrees F.

2.1.7.7 Relief Valves

Bronze body, Teflon seat, stainless steel stem and springs, automatic, direct pressure actuated capacities ASME certified and labeled.

2.1.7.8 Valve Operating Mechanisms

Provide power operators and extension stems where indicated and as specified.

a. Power Operators: Shall be electric. Power operated valves shall open and close at rates no slower than 10 inches per minute for gate valves and 4 inches per minute for globe and angle valves. Valves shall open fully or close tightly without requiring further attention when the actuating control is moved to the open or close position. A predetermined thrust exerted on the stem during operation resulting from an obstruction in the valve shall cause the motor to automatically stop. Power operators shall be complete with all gearing and controls necessary for the size of valve being provided. Power operators shall be designed to operate on the electric power supply indicated.

b. Extension Stem: Corrosion resisting steel designed for rising and non-rising stems. Provide in length required to connect the valve stem and the operating mechanism and of sufficient cross section to transfer the torque required to operate the valve.

2.1.7.8 Balancing Valves

Balancing valves shall be calibrated bronze body balancing valves with integral ball valve and venturi or valve orifice and valve body pressure taps for flow measurement based on differential pressure readings. Valve pressure taps and meter connections shall have seals and built-in check valves with threaded connections for a portable meter. Meter shall be provided by the same manufacturer and be capable of reading system pressures and shall meet the requirements of the paragraph entitled "Flow Measuring Equipment." Valves shall have internal seals to prevent leakage around rotating element and be suitable for full shut-off rated pressure. Valves shall have an operator with integral pointer and memory stop. Balancing valves shall be selected for the required flows as indicated on the plans.

2.1.8 End Connections

2.1.8.1 Flexible Connectors

Provide flexible pipe connectors on piping connected to equipment. Flexible section shall consist of rubber, Tetrafluoroethylene resin, corrosion-resistant steel, bronze, Monel, or galvanized steel. Material provided and configuration shall be suitable for pressure temperature, and circulating medium.

Flexible section shall have threaded, or flanged ends and shall be suitable for service intended.

Flexible section may be reinforced with metal retaining rings, with built-in braided wire reinforcement and restriction bolts or with wire braid cover suitable for service intended.

2.1.8.2 Steel Piping

Screwed or socket welded for 2 inches and smaller and flanged or butt welded for 2 1/2 inches and larger.

a. Screwed Joints with Taper Threads: ANSI/ASME B1.20.1.

b. Flanged Joints: Bolting and gaskets shall be as follows:

(1) Bolting: Bolt and stud material ASTM A 307, Grade B, and nut Material ASTM A 194/A, Grade 2. Bolt, stud, and nut Dimensions ASME/ANSI B18.2.2 threads ASME B1.1coarse type with Class 2A fit for bolts and studs, and Class 2B fit for nuts. Bolts or bolt studs shall extend completely through the nuts and May have reduced shanks of a diameter not less than the diameter at root of threads. Carbon steel bolts shall have American Standard regular square or heavy hexagon heads and shall have American Standard heavy semi-finished hexagonal nuts conforming to ASME/ANSI B18.2.2.

(2) Gaskets: ASME B16.21, Non-asbestos compressed material 1/16 inch thickness full face or self-centering flat ring type and suitable for pressure and temperature of the piping system.

c. Butt Weld Joints: ASME/ANSI B31.9. Backing rings shall conform to ASME/ANSI B31.9. Ferrous rings shall not exceed 0.05 percent sulfur; for alloy pipe, backing rings shall be of material compatible with the chemical composition of the parts to be welded and preferably of the same composition. Provide continuous machined or split band backing rings.

d. Socket Weld Joints: ASME/ANSI B31.9.

2.1.8.3 Joints for Copper Tubing

a. Solder conforming to ASTM B 32 alloy grade Sb5 or Sn96. Solder and flux shall be lead free (less than 0.2 percent of lead).

b. Copper Tube Extracted Joint: An extracted mechanical tee joint may be made in copper tube. Make joint with an appropriate tool by drilling a pilot hole and drawing out the tube surface to form a collar having a minimum height of three times the thickness of the tube wall. To prevent the branch tube from being inserted beyond the depth of the extracted joint, provide dimpled depth stops. Notch the branch tube for proper penetration into fitting to assure a free flow joint. Braze extracted joints using a copper phosphorous classification brazing filler metal. Soldered joints shall not be permitted.

2.1.8.4 Instrumentation

2.1.8.5 Pressure Gauges

Provide ANSI/ASME B40.1 with restrictor.

2.1.8.6 Indicating Thermometers

Thermometers shall be dial type with an adjustable angle suitable for the service. Provide thermowell sized for each thermometer in accordance with the thermowell specification. Fluid-filled thermometers

(mercury .is not acceptable) shall have a nominal scale diameter of 9 inches. Construction shall be stainless-steel case with molded glass cover, stainless-steel stem and bulb. Stem shall be straight, length as required to fit well. Bimetal thermometers shall have a scale diameter of 4-1/2 inches. Case shall be hermetic. Case and stem shall be constructed of stainless steel. Bimetal stem shall be straight and of a length as required to fit the well.

2.1.8.7 Pressure/Temperature Test Ports

Pressure/Temperature Test Ports shall have brass body and EPDM and/or Neoprene valve seals. Ports shall be rated for service between 35 and 275 degrees F and up to 500 psig. Ports shall be provided in lengths appropriate for the insulation thickness specified in Section 15080, "Mechanical Insulation" and installed to allow a minimum of 12 inches of access for probe insertion. Provide with screw-on cap attached with a strap or chain to prevent loss when removed. Ports shall be 1/4 inch NPT and accept 1/8 inch diameter probes.

2.1.8.8 Air Vent

Provide heavy duty float type air vent in hydronic systems. Vent shall be constructed of brass or semi-steel body, copper float, and stainless steel valve and valve seat. Design air vent to suit system operating temperature and pressure. Provide isolating valve to permit service without draining the system. Pipe discharge of vent to a drain.

2.1.8.9 Strainers

Strainers for classes 125 and 250 piping in 1/2 to 8 inches, inclusive, FS WW-S-2739 and locate as indicated.

2.1.8.10 Hangers and Supports

Design and fabrication of pipe hangers, supports, and welding attachments shall conform to MSS SP-58 and ASME/ANSI B31.9. Hanger types and supports for bare and covered pipe shall conform to MSS SP-69 for the temperature range.

2.1.8.11 Pipe Sleeves

Sleeves in masonry and concrete walls, floors, and roof slabs shall be ASTM A 53, Schedule 40 or Standard Weight, hot-dip galvanized steel or ductile-iron pipe. Sleeves in partitions shall be zinc-coated sheet steel having a nominal weight of not less than 4.40 kilogram per square meter 0.906 pound per square foot.

2.1.8.12 Escutcheon Plates

Provide one piece or split hinge metal plates for piping passing through floors, walls, and ceilings in exposed spaces. Provide polished stainless steel plates or chromium-plated finish on copper alloy plates in finished spaces and paint finish on metal plates in unfinished spaces.

2.2 CENTRAL MECHANICAL EQUIPMENT

2.2.1 Boilers

Provide as specified in Section 15515, "Low Pressure Water Heating Boilers."

## 2..3 PIPING SYSTEM EQUIPMENT

### 2.3.1 Pumps

Provide hot water circulating pumps. Pump casing and flange shall be made of close-grained cast iron. Shaft shall be carbon or alloy steel with lubricated bearings and impeller shall be bronze. Select pumps so that the operating point on selected impeller-curve will lie at or to the left of shutoff side of, and not more than 5 percent below, point of maximum efficiency for impeller. Provide motors of totally enclosed type conforming to NEMA MG 1 and suitable for electrical characteristic as indicated. Motor starters shall conform to NEMA ICS 2 across the line type with NEMA ICS 6 weather-resistant enclosure.

### 2.3.2 Expansion Tanks

Provide welded steel bladder type tanks, constructed and tested hydrostatically in accordance with ASME BPVC SEC VIII D1. Tank shall be equipped with all necessary fittings. The tank and fittings shall be pressure rated at minimum of 125 psig and diaphrams and bladders shall separate system water from air side of bladder. Design bladder for tank pressure rating.

### 2.3.3 External Air Separation Tanks

Provide tank constructed of steel, designed for not less than 125 psig, and constructed and tested in accordance with the requirements of ASME BPVC SEC VIII D1. Provide tangential inlet and outlet connections, flanged for sizes 2 1/2 inches and larger. Each unit shall have an internal design suitable for. creating the required vortex and subsequent air separation. Provide with automatic air release device.

## 2.4 TERMINAL UNITS

### 2.4.1 Unit Heaters

Provide hot water unit heaters as specified in Section 15760, "Terminal Heating and Cooling Units."

## 2.5 ELECTRICAL EQUIPMENT

Provide complete with motors, motor starters, thermal overload protection, and controls. Equipment and wiring shall be in accordance with Section 16402, "Interior Distribution System."

## 2.6 CONTROLS

Provide controls as specified in Section 15910, "Space Temperature Control Systems."

## 2.7 INSULATION

Provide shop and field applied insulation as specified in Section 15080, "Mechanical Insulation."

## 2.8 ASBESTOS PROHIBITION

Asbestos and asbestos containing products are prohibited.

# PART 3 - EXECUTION

## 3.1 PREPARATION

Provide storage for equipment and material at the project site. All parts shall be readily accessible for inspection, repair, and .renewal. Protect material and equipment from the weather.

## 3.2 INSTALLATION

Piping fabrication, assembly, welding, soldering, and brazing shall conform to ASME/ANSI B31.9. Piping shall follow the general arrangement shown. Route piping and equipment within buildings out of the way of lighting fixtures and doors, windows, and other openings. Run overhead piping in buildings in inconspicuous positions. Provide adequate clearances from walls, ceilings, and floors to permit welding of joints and application of insulation. Make provision for expansion and contraction of pipe lines. Make changes in size of water lines with reducing fittings. Do not bury, conceal, or insulate until piping has been inspected, tested, and approved.

Do not run piping concealed in walls, partitions, underground, or under the floor except as otherwise indicated. Where pipe passes through building structure, locate pipe joints and expansion joints where they may be inspected. Provide flanged joints where necessary for normal maintenance and where required to match valves and equipment. Furnish gaskets, packing, and thread compounds suitable for the service. Provide long radius ells where possible to reduce pressure drops. Pipe bends in lieu of welding fittings may be used where space permits. Pipe bends shall have a uniform radius of at least five times the pipe diameter and shall be free from appreciable flattening, wrinkling, or thinning of the pipe. Do not use mitering of pipe to form elbows, notching straight runs to form full sized tees, or any similar construction. Make branch connections over 2 inches with welding tees except factory made forged welding branch outlets or nozzles having integral reinforcements conforming to ASME/ANSI B31.9 may be used, provided the nominal diameter of the branch is at least one pipe size less than the nominal diameter of the run. Branch connections 2 inches and under can be threaded or welded.

Run vertical piping plumb and straight and parallel to walls. Provide sleeves for lines passing through building structure. Provide a fire seal where pipes pass through fire wall, fire partitions, fire rated pipe chase walls, or floors above grade. Install piping connected to equipment with flexibility for thermal stresses and for vibration, and support and anchor so that strain from weight and thermal movement of piping is not imposed on the equipment.

### 3.2.1 Hangers and Supports

Unless otherwise indicated, horizontal and vertical piping attachments shall conform to MSS SP-58. Band and secure insulation protection shields without damaging pipe insulation. Continuous inserts and expansion bolts may be used.

### 3.2.2 Grading of Pipe Lines

Unless otherwise indicated, install horizontal lines of hot water piping to grade down in the direction of flow with a pitch of not less than one inch in 30 feet, except in loop mains and main headers where the flow may be in either direction.

### 3.2.3 Pipe Sleeves

Provide sleeves where pipes and tubing pass through masonry or concrete walls, floors, roof, and partitions. Annular space between pipe, tubing, or insulation and the sleeve shall not be less than 1/4 inch.

Hold sleeves securely in proper position and location before and during construction. Sleeves shall be of sufficient length to pass through entire thickness of walls, partitions, or slabs. Sleeves in floor slabs shall extend 2 inches above finished floor. Firmly pack space between pipe or tubing and sleeve with oakum and caulk on both ends of the sleeve with plastic waterproof cement which will dry to a firm but pliable mass, or provide a mechanically adjustable segmented elastomeric seal. Seal both ends of penetrations through fire walls and fire floors to maintain fire resistive integrity with UL listed fill, void, or cavity material.

3.2.4 Flashing for Buildings

Provide flashing where pipes pass through building roofs, and make outside walls tight and waterproof.

3.2.5 Unions and Flanges

Provide unions and flanges to permit easy disconnection of piping and apparatus. Each connection having a screwed-end valve shall have a union. Place unions and flanges no farther apart than 100 feet. Install unions downstream of valves and at equipment or apparatus connections. Provide unions on piping under 2 inches in diameter, and provide flanges on piping 2 inches and over in diameter. Provide dielectric unions or flanges between ferrous and non-ferrous piping, equipment, and fittings; except that bronze valves and fittings may be used without dielectric couplings for ferrous-to-ferrous or non-ferrous-to-non-ferrous connections.

Provide reducing fittings for changes in pipe size; reducing bushings are not permitted.

3.2.6 Connections for Future Equipment

Locate capped or plugged outlets for connections to future equipment as indicated.

3.2.7 Changes in Pipe Size

In horizontal lines, provide eccentric reducing fittings to maintain the top of the lines in the same plane.

3.2.8 Cleaning of Pipe

Thoroughly clean each section of pipe, fittings, and valves free of foreign matter before erection. Prior to erection, hold each piece of pipe in an inclined position and tap along its full length to loosen sand, mill scale and other foreign matter. For pipe 2 inches and larger, draw wire brush, of a diameter larger than that of the inside of the pipe, several times through the entire length of pipe. Before making final connections to apparatus, wash out interior of piping thoroughly with water. Plug or cap open ends of mains during shutdown periods. Do not leave lines open where foreign matter might enter the pipe.

3.2.9 Valves

Install valves in conformance with ASME/ANSI B31.9. Provide gate valves unless otherwise directed. Install valves with stems horizontal or above. Locate or equip stop valves to permit operation from floor level, or provide with safe access in the form of walkways or ladders. Install valves in positions accessible for operation and repair.

3.2.9.1 Globe Valves

Install globe valves so that the pressure is below the disk and the stem horizontal.

3.2.10 Pressure Gage

Provide a shut-off valve or pet cock between pressure gages and the line.

3.2.11 Thermometers

Provide thermometers and thermal sensing elements of control valves with a separable socket. Install separable sockets in pipe lines in such a manner to sense the temperature of flowing the fluid and minimize obstruction to flow.

3.2.12 Strainers

Provide strainers, with meshes suitable for the services, where indicated, or where dirt might interfere with the proper operation of valve parts, orifices, or moving parts of equipment.

3.2.13 Pumps

Select pumps for specified fluid temperatures, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve. Support piping adjacent to pump such that no weight is carried on pump casings. Install close coupled and base mounted pumps on concrete base, with anchor bolts, set and level, and grout in place and provide supports under elbows on pump suction and discharge .line sizes 4 inches and over. Lubricate pump before start-up.

3.2.14 Equipment Foundations

Locate equipment foundations as shown on the drawings. Size, weight, and design shall preclude shifting of equipment under operating conditions. Foundations shall meet the requirements of the equipment manufacturer. Concrete shall conform to Section 03300, "Cast-In-Place-Concrete," and grout shall be approved non-shrinking.

3.2.15 Equipment- Installation

Install equipment in accordance with installation instructions of the manufacturers. Grout equipment mounted on concrete foundations before installing piping. Install piping in such a manner as not to place a strain on the equipment. Do not bolt flanged joints tight unless -they match. Grade, anchor, guide, and support piping without low pockets.

3.2.16 Cleaning of Systems

As installation of the various system components is completed, fill, start, and vent prior to cleaning. Place terminal control valves in open position. Add cleaner to closed system at concentration as recommended by manufacturer. Apply heat while circulating, slowly raising temperature to 160 degrees F and maintain for 12 hours minimum. Remove heat and circulate to 100 degrees F or less; drain systems as quickly as possible and refill with clean water. Circulate for 6 hours at design temperatures, then drain. Refill with clean water and repeat until system cleaner is removed. Use neutralizer agents on recommendation of system cleaner supplier and approval of Contracting Officer. Remove, clean, and replace strainer screens. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required. Preliminary or final tests are not permitted until cleaning is approved.

3.2.17 Painting of Piping and Equipment

Provide in accordance with Section 09900, "Paints and Coatings."

3.2.18 Identification of Piping

Identify piping in accordance with OSHA 29 CFR 1910.144, except that labels or tapes may be used in lieu of painting or stenciling. Spacing of identification marking on runs shall not exceed 50 feet. Materials for labels and tapes shall conform to CID A-A-1689, and shall be general purpose type and color class. Painting and stenciling shall conform to Section 09900, "Paints and Coatings."

3.3 FIELD QUALITY CONTROL

Perform inspections and tests as specified herein to demonstrate that piping and equipment, as installed, is in compliance with contract requirements. Start up and operate the system. During this time, periodically clean the various strainers until no further accumulation of foreign material occurs. Exercise care so that minimum loss of water occurs when strainers are cleaned. Adjust safety and automatic control instruments to place them in proper operation and sequence.

3.3.1 Hydrostatic Test of Piping System

Test piping system Hydrostatically using water not exceeding 100 degrees F. Conduct tests in accordance with the requirements of ASME/ANSI B31.9 and as follows. Test piping system after all lines have been cleaned and before applying insulation covering. Remove or valve off from the system, gages, and other apparatus which may be damaged by the test before the tests are made. Install calibrated test pressure gage in the system to observe any loss in pressure. Maintain test pressure for a sufficient length of time to enable an inspection of each joint and connection. Perform tests after installation and prior to acceptance. Notify the Contracting Officer in writing 7 days prior to the time scheduled for the tests.

3.3.2 Auxiliary Equipment and Accessory Tests

observe and check pumps, accessories, and equipment during operational and capacity tests for leakage, malfunctions, defects, noncompliance with referenced standards, or overloading.

3.4 TESTING, ADJUSTING, AND BALANCING

Except as specified herein, perform in accordance with SMACNA HVACTAB, Chapter VIII "Hydronic System TAB Procedures," drawings and specifications; prepare complete report of final test results. Test, adjust, and balance the hydronic system in accordance with Section 15950, "HVAC Testing/Adjusting/Balancing."

3.4.1 Markings of Settings

Following final acceptance of the balancing report, the settings of all valves, splitters, dampers, and other adjustment devices shall be permanently marked so that adjustment can be restored if disturbed at anytime.

END OF SECTION